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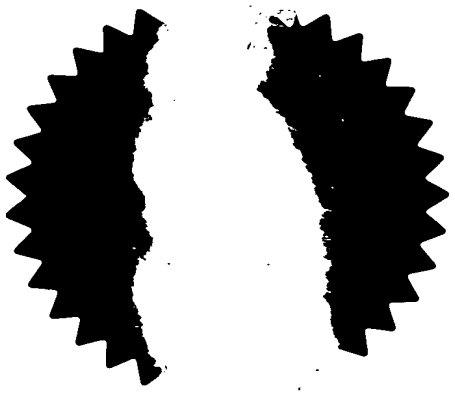

Signed Stephen Hurdle.

Dated 1 July 2003

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The **Patent Office**

12SEP02 E747613-1 D01520
P01/7700 0.00-0221083.9

Request for grant of a patent

The Patent Office

Cardiff Road
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Gwent NP10 8QQ

1. Your reference: 202-0892GB/RMF

2. Patent application number: 0221083.9 12 SEP 2002

3. Full name, address and postcode of the or of each applicant.

Ford Global Technologies, Inc.
Suite 600, Parklane Towers East
One Parklane Boulevard, Dearborn
Michigan 48126-2490
USA

Patents ADP number: 81001250002

If the applicant is a corporate body, give the country/state of its incorporation: Michigan, United States of America

4. Title of the invention: **Motor Vehicle Fuel Systems**

5. Name of your agent

"Address for service" in the United Kingdom to which all correspondence should be sent.

R M Farrow et al

Land Rover
Patent Department 53W5/12
Warwick Technology Park
Warwick CV34 6RG

Patents ADP Number: 80190360003

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or each of these earlier applications and the or each application number.

Country	Priority application number	Date of filing

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing

8. Is a statement of inventorship and of right to grant of a patent required in support of this request.

YES

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	5
Claim(s)	2
Abstract	1
Drawing(s)	2

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	1+1
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature

Date
12 September 2002

R M Farrow Agent

12. Name and daytime telephone number of person to contact in the United Kingdom.

R M Farrow 01926 482150

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Patents Form 7/77

The Patent Office

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(Rule 15)

Statement of inventorship and of right to grant of a patent

Th Patent Office

Cardiff Road
Newport
Gwent NP10 8QQ

1. Your reference	202-0892GB/RMF
2. Patent application number	0221083.9 12 SEP 2002
3. Full name of the or of each applicant.	Ford Global Technologies, Inc.
4. Title of the invention	**Motor Vehicle Fuel Systems**
5. State how the applicant(s) derived the right from the inventor(s) to be granted a patent	By virtue of agreements giving rights to inventions made by the employer of the inventor(s)
6. How many, if any, additional Patents Forms 7/77 are attached to this form?	
7.	I/we believe that the person(s) named over the page *(and on any extra copies of this form)* is/are the inventor(s) of the invention which the above patent application relates to. Signature: R M Farrow Agent Date: 12 September 2002
8. Name and daytime telephone number of person to contact in the United Kingdom.	R M Farrow 01926 482150

Patents Form 7/77

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Enter the full names, addresses and postcodes of the inventors in the boxes and underline the surnames

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Motor Vehicle Fuel System

The invention relates to motor vehicle fuel systems of the kind which includes a fuel tank and a pipe, generally known as a filler neck, which extends from a convenient position on the outside of the vehicle and opens into the tank for introducing liquid fuel into the tank. A problem with such fuel systems is that gases and fuel vapours are released during the filling of the tank. Certain types of filling apparatus capture and monitor release of such gases and vapours to cut off the fuel delivery if the volume of gas and vapour release exceeds a particular rate. This can be an impediment to the effective filling of the fuel tank, particularly when the vehicle is being fuelled for the first time on the vehicle production line.

Hence it is an object of the invention to provide a motor vehicle fuel system in which the release of gases and vapours can be reduced.

According to the invention there is provided a motor vehicle fuel system including a fuel tank, an inlet duct having an upper end for receiving liquid fuel from a fuel dispensing apparatus and a lower end opening into the tank for introducing liquid fuel into the tank and a tubular sock of a porous flexible material which is attached at one end to the lower end of the inlet duct and in use can float on the surface of fuel in the tank.

Preferably, the sock is open at its other end.

Preferably, the sock extends substantially to the base of the tank when the tank is empty.

The sock may be of a knitted or woven material. Conveniently the sock has a porosity equivalent to filtration in the range 20 to 80 micron (μm) and preferably about 50 micron (μm).

A cage may be provided for supporting said one end of the duct. Conveniently, the filler neck opens into the tank at a filler neck connector which includes the cage. The cage

may have windows covered by the material of the sock. The filler neck connector may include a check valve and be arranged such that the windows are immediately adjacent the check valve. The check valve may include a spring-loaded flap covering an exit orifice of the filler neck connector. In such an arrangement the cage helps to prevent the sock impeding the action of the check valve and discharge is in the region of the windows

The invention will now be described by way of example and with reference to the accompanying drawings, in which:-

Fig.1 is a diagrammatic cross section of a fuel tank and a filler neck of a motor vehicle fuel system according to the invention with certain components omitted for clarity;

Fig.2 is a view based on Fig.1 showing an empty fuel tank and with a porous flexible tubular sock in place;

Fig.3 is a view similar to Fig.2 showing the fuel tank during filling;

Fig.4 is a perspective view of a filler neck connector as fitted to the fuel tank shown in Figs.1 to 3; and

Fig.5 is a side elevation of the filler neck connector shown in Fig.4.

In the drawings, a motor vehicle fuel tank 11 has a filler neck connector 12 secured (e.g. by welding or adhesive) to a flared collar 13 formed as part of the tank 11. A filler neck 14 is connected to the neck connector 12 and to a filler head 15 which incorporates a conventional valve to avoid fuel spillage, the filler head 15, filler neck 14 and neck connector 12 together forming an inlet duct for the tank 11. A vent pipe 16 connects from the top of the tank 11 to the filler head 15 to allow gases and vapours to escape from the space above the fuel, these gases and vapours being removed by the filling apparatus at the filling station. A breather pipe 17 is connected to an engine of the vehicle through a carbon canister filter in a conventional manner.

The filler neck connector 12, as is more clearly shown in Figs.4 and 5, comprises a tubular body 18 having a stub 21 for connecting the filler neck 14 and a flange 22 welded to

the collar 13. A check valve 23 having a spring-loaded flap 31 which normally covers an exit orifice 32 in the filler neck body 18 is provided to prevent backflow of liquid fuel. As described so far, the neck connector 12 is conventional. However, in accordance with the invention, there is a tubular support cage 24 of moulded plastics material including a portion with a solid wall and an open portion with windows 25 in the region of the check valve 23. The cage is secured to the connector flange 22 at the solid wall end, e.g. by friction welding, to leave an annular space between the cage 22 and the tubular body 18.

The cage 24 is used to support and retain one end of a tubular duct or sock 26 of a porous flexible material, e.g. a woven nylon mesh. Fig.1 shows the tank 11 and associated components without the sock 26 whereas Fig.2 shows the sock 26 in place when the tank 11 is empty. The sock has a mesh size equivalent to 50 micron (μm) filtration and is open at its other end, i.e. the end remote from the filler neck 14. Conveniently the sock 26 is secured to the cage 24 by placing the sock over a mandrel and overmoulding the cage onto it. In this way the sock 26 is also secured to the cage 24 in the region of the windows 25.

The flexibility of the sock 26 is such that it hangs down limply when the tank is empty, as depicted in Fig.2, but when the tank 11 is being filled the fuel tends to fill out the inside of the sock as the fuel is ducted through it. The incoming fuel brings with it gases and vapours which are released as the fuel flows down the filler neck 14 and through the sock 26 itself. Hence this fuel is an effervescent two-phase mixture which is of lower density than the liquid fuel already in the tank so that as the fuel level rises the sock 26 floats to the surface 27 of the fuel 28 contained in the tank 11. This allows the fuel to flow onto the fuel surface 27 rather than splash down onto it. Moreover, the porosity of the sock 26 is such that a substantial proportion of the incoming fuel flows through the wall of the sock 26. Because this flow is over a large area, the velocity is low and there is a reduced tendency for gases and vapours to be released. The windows 25 in the support cage 24 are immediately adjacent the flap of the check valve 23 and this allows some of the liquid fuel

to flow through the windows sock 26 as it emerges through the check valve orifice 32 and also prevents the sock interfering with the action of the check valve flap 31.

By reducing the release of gases and vapours, there is a reduced backflow through the vent pipe 16 so that the tank can be fuelled at a reasonable rate without triggering the automatic cut off mechanism used in the filling apparatus. This is particularly useful where the filler head 15 and the associated filling apparatus is of the fully sealed type where all the gases and vapours are collected without escaping to the atmosphere.

The material of the sock 26 may be of a mesh size equivalent to filtration in the range 20-80 micron (μm) and whilst a woven material providing 50 micron (μm) filtration is preferred, appropriate knitted material may be found to perform satisfactorily. In general, if the porosity of the material is too great, the fuel tends to spray through the wall of the sock 26 so its effect in reducing the release of gases and vapour is impaired. Conversely, if the porosity of the material is too low, the majority of the fuel flow is through the end of the sock and this can result in an unwanted back-pressure.

The length of the sock 26 is preferably such that it should just touch the base of the tank 11 when hanging with the tank empty as in Fig.2. In a typical vehicle installation this is about 300mm. The sock 26 may be longer than this but should preferably not exceed the width of the tank 11, i.e. it should extend no further than the wall opposite the filler neck 14, and provided that the back-pressure is not increased unduly. Other constraints may be relevant, e.g. avoiding the fuel pump module and in practice the optimum length can be determined by trial and error during vehicle development. The diameter of the sock 26 is typically about 50mm, this being a convenient size for the sock and its cage to fit over the filler neck connector body 18.

Although a sock 26 with an open end is shown and described, the sock may have a closed end if the required flow rate is such that the back-pressure is not increased unduly

and the velocity of the fuel flow through the wall of the sock is not such that this induces undue release of gases and vapours. This might be achieved by using a sock of a larger diameter, thereby increasing the effective area for flow though the sock wall.

CLAIMS

1. A motor vehicle fuel system including a fuel tank, an inlet duct having an upper end for receiving liquid fuel from a fuel dispensing apparatus and a lower end opening into the tank for introducing liquid fuel into the tank and a tubular sock of a porous flexible material which is attached at one end to the lower end of the inlet duct and in use can float on the surface of fuel in the tank.

2. A fuel system according to claim 1 wherein the sock is open at its other end.

3. A fuel system according to claim 1 or claim 2 wherein the sock extends substantially to the base of the tank when the tank is empty.

4. A fuel system according to any preceding claim wherein the sock has a porosity equivalent to filtration in the range 20 to 80 micron (μm)

5. A fuel system according to claim 4 wherein the porosity is substantially equivalent to 50 micron (μm) filtration.

6. A fuel system according to any preceding claim and further comprising a cage for supporting said one end of the duct.

7. A fuel system according to claim 6 wherein the filler neck opens into the tank at a filler neck connector which includes the cage.

8. A fuel system according to claim 7 wherein the cage has windows covered by the material of the sock.

9. A fuel system according to claim 8 wherein the filler neck connector includes a check valve and the windows are immediately adjacent the check valve.

10. A fuel system according to claim 9 wherein the check valve includes a spring-loaded flap covering an exit orifice of the filler neck connector.

11. A motor vehicle fuel system substantially as described herein with reference to the accompanying drawings.

ABSTRACT (Fig.3)

Motor Vehicle Fuel System

A motor vehicle fuel tank 11 has a filler neck connector 12, a filler neck 14 and a filler head 15 which incorporates a conventional valve to avoid fuel spillage, the filler head 15, filler neck 14 and neck connector 12 together forming an inlet duct for the tank 11. A tubular support cage 24 of moulded plastics material is secured to the connector body 18 and supports and retains one end of a tubular sock 26 of porous flexible nylon mesh equivalent to 50 micron (μm) filtration. The sock 26 is open at its other end, i.e. the end remote from the filler neck 14. The flexibility of the sock 26 is such that it hangs down limply when the tank is empty (as depicted in Fig.2) but when the tank 11 is being filled the fuel tends to fill out the inside of the sock so that a substantial proportion of the fuel is ducted through it. As the fuel level rises the sock 26 floats to the surface 27 of the fuel 28 contained in the tank 11 to allow the fuel to flow onto the fuel surface 27 rather than splash down onto it.

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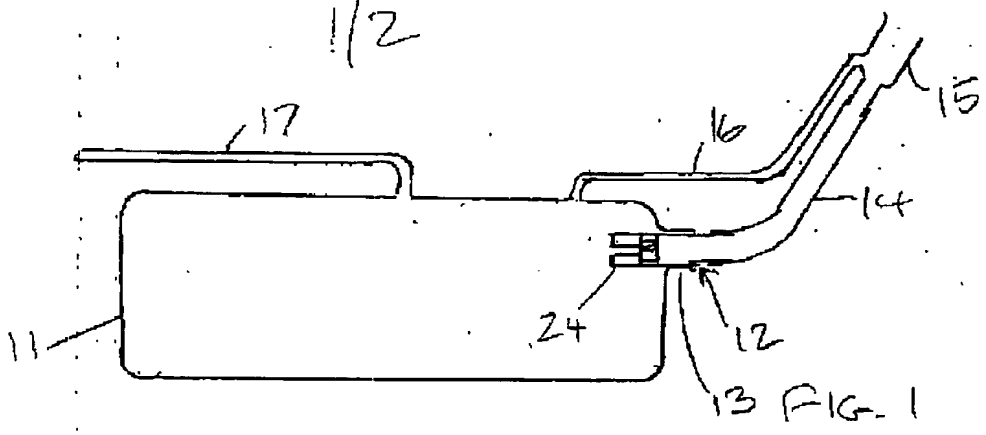

FIG. 1

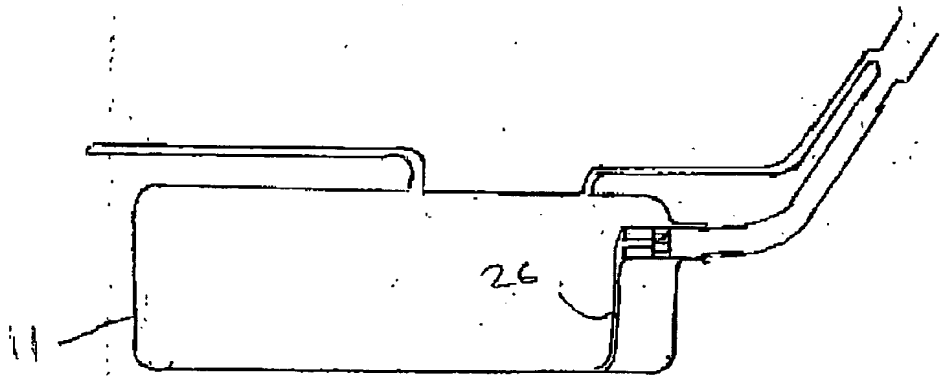

FIG. 2

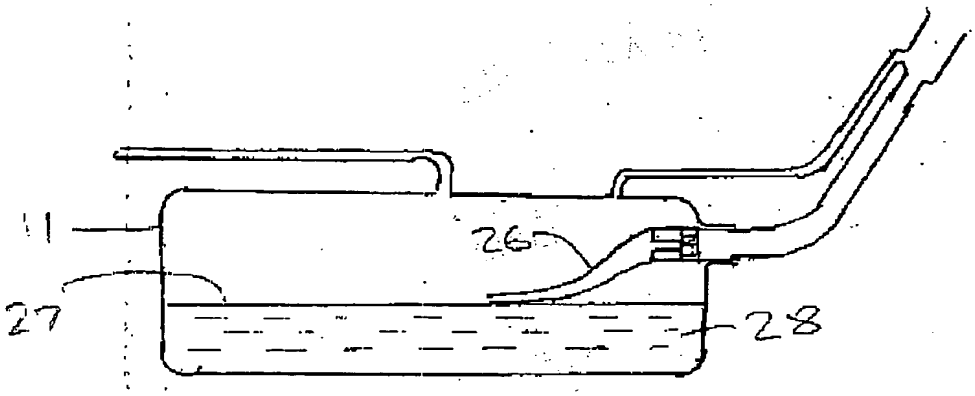

FIG. 3

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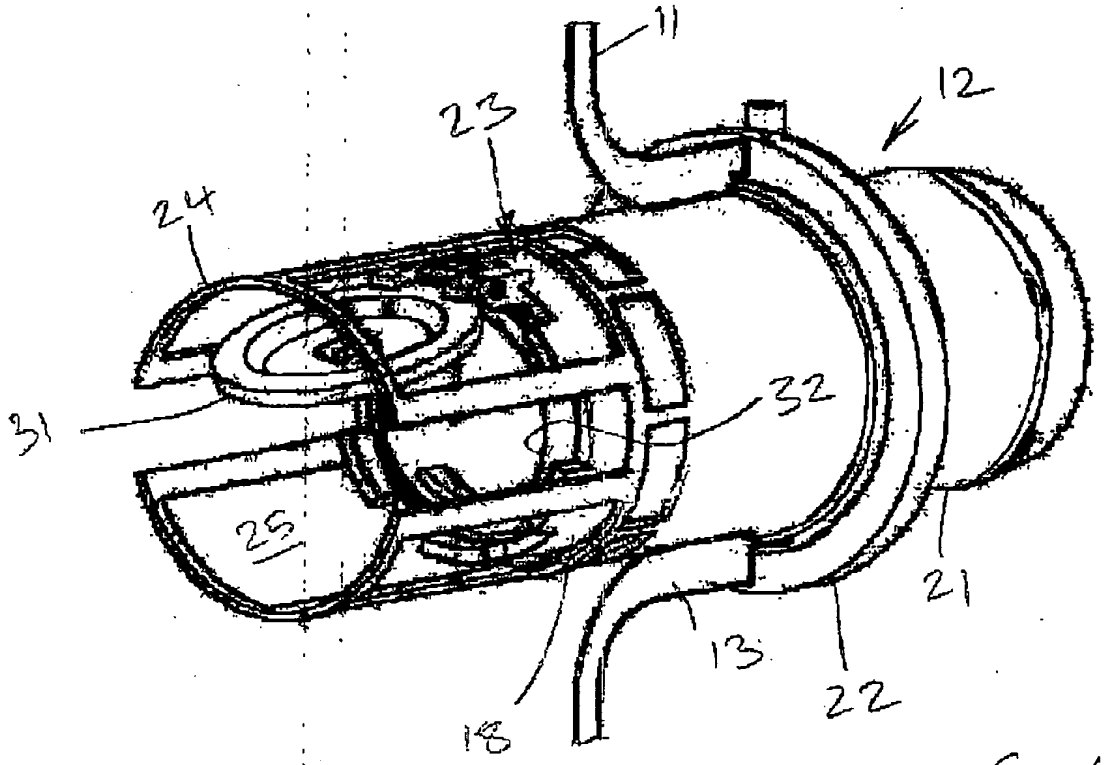

FIG. 4

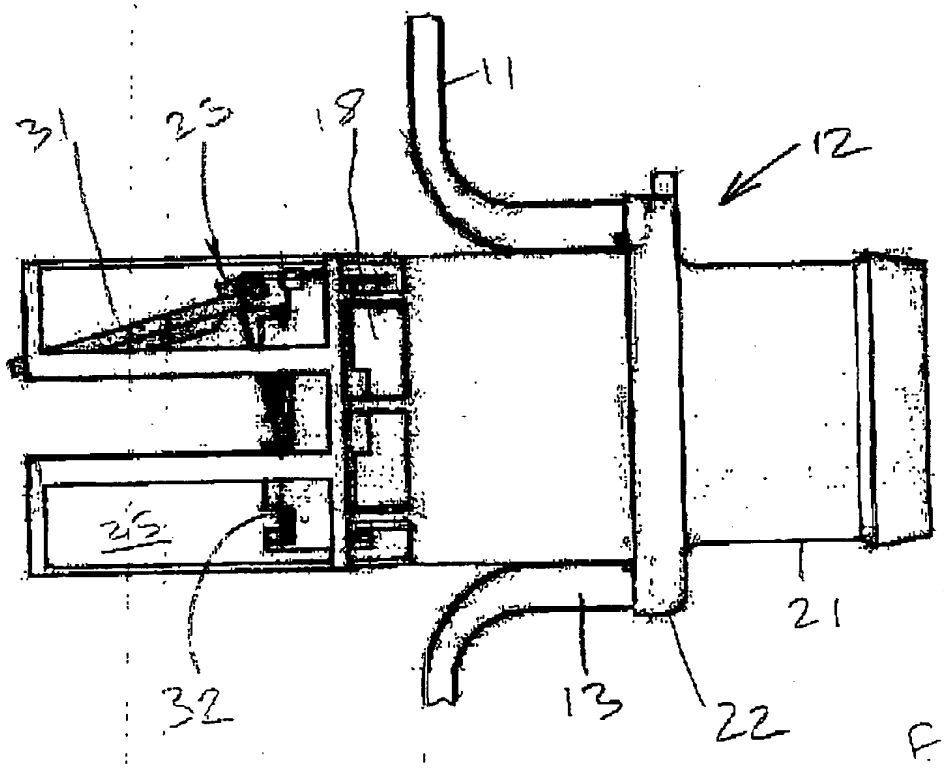

FIG. 5